NO
PAPER
RIGHTS

REIMPRESSION
INTERDITE

UBC Centre for Human Settlements

# EMERGENCY PREPAREDNESS PLANNING

## Hazard Management Planning in British Columbia: Issues and Challenges

Peter Anderson, Nathan Edelson,
Betty Hansen, Ruth Harding,
Kari Huhtala, Laurie Laughy

July 1990

**A Discussion Paper Prepared by the Forum for Planning Action**

THE UNIVERSITY OF BRITISH COLUMBIA

91-00556/

**Emergency Preparedness Planning**

A series of research and discussion papers published by:

UBC Centre for Human Settlements
THE UNIVERSITY OF BRITISH COLUMBIA
2206 East Mall, Vancouver, B.C. V6T 1W5
(604) 228-5254; Fax (604) 228-6164

© UBC Centre for Human Settlements 1990

ISBN 0-88865-359-X

# EMERGENCY PREPAREDNESS PLANNING

## Hazard Management Planning in British Columbia: Issues and Challenges

Peter Anderson, Nathan Edelson,
Betty Hansen, Ruth Harding,
Kari Huhtala, Laurie Laughy

July 1990

**A Discussion Paper Prepared by the Forum for Planning Action**

## Contents


1. **Introduction** ..... 1

2. **Natural and Human-Induced Hazards** ..... 2
   - 2.1 Human-Induced Hazards ..... 2
   - 2.2 Natural Hazards ..... 5
   - 2.3 Earthquakes ..... 5
   - 2.4 Tectonic Plate Activity ..... 8
   - 2.5 Conclusion ..... 10

3. **A Synopsis of the City of Vancouver Emergency Plan** ..... 11

4. **Emergency Communications in the Lower Mainland Region of British Columbia** ..... 14
   - 4.1 Alerting ..... 14
   - 4.2 Warning ..... 15
   - 4.3 Informing ..... 15
   - 4.4 Directing and Coordinating (Command) ..... 16
   - 4.5 Special Protection for Telephones ..... 18
   - 4.6 Recommendations ..... 19

5. **Emergency Planning -- A Planning Process for the Next Decade** ..... 20
   - 5.1 Community Preparedness ..... 21
   - 5.2 Alert and Warning ..... 21
   - 5.3 Immediate Post-Impact ..... 22
   - 5.4 Reconstruction and Renewal ..... 23
   - 5.5 Land Use Planning ..... 24

6. **Recommendations** ..... 25
   - 6.1 Community Preparedness ..... 25
   - 6.2 Alert and Warning ..... 26
   - 6.3 Immediate Post-Impact ..... 27
   - 6.4 Recovery and Reconstruction ..... 27
   - 6.5 Land Use Planning ..... 27

**References** ..... 28

## *1. Introduction*

This paper explores the need for a more coordinated and comprehensive approach to hazard management planning in British Columbia. It is our intent to provoke discussion and thereby help define solutions.

The first section, natural and human-induced hazards, describes the kinds of disasters that are likely to take place in the Lower Mainland. Toxic spills, land slides, and floods occur periodically and have localized impacts. A major earthquake is likely to occur and will create multiple, catastrophic effects.

With these possible effects in mind, the second section presents a synopsis of the City of Vancouver's Emergency Plan. The plan focuses primarily on effective immediate post-impact response to minimize public injury and property damage. It consists of strategies for communications, transport routes, and emergency support services.

The third section highlights emergency communications. It emphasizes the need for advance preparations - establishing direct emergency communication systems between key government officials, hospitals, fire, police, and other critical responders; preparing and involving the media; and training volunteer radio operators.

The final section outlines a comprehensive approach to hazard management planning through four phases: community preparedness, alert and warning, immediate post-impact, and reconstruction and renewal. It highlights the need for land use planners to include hazard and risk analyses in their approval process and also calls for the establishment of local reception centres to provide comprehensive service to help communities reestablish themselves after the immediate impact period.

These papers were prepared under the sponsorship of the Forum for Planning Action (FPA), which is a non-profit organization advocating the need for planning, with an emphasis on citizen involvement in planning processes in British Columbia.

## 2. Natural and Human-Induced Hazards

The following discussion gives a general overview of some natural and human-induced hazards and disasters in the Lower Mainland of British Columbia. It focuses on earthquakes because of the multiple impacts on the natural, economic and human environment generated by events of their magnitude. Examples of types of damage expected from a severe earthquake in the Lower Mainland are presented.

A hazard is defined as a dangerous situation which, by virtue of its existence, creates a risk of disaster. It can be natural or human-induced. Both hazards and disasters can be local or regional in their impact. On a local level a disaster can be described as an event or situation which exceeds the capabilities of the municipality or city to deal with it. To reduce the impact of such events, a strong central group must coordinate emergency preparedness systems which are capable of dealing with both catastrophic events and smaller crises. Emergency preparedness and response schemes should be geared to address disasters of various degrees of severity as regional resources may be stretched to the breaking point.

The range of potential hazards and associated impacts for the Lower Mainland are listed in Figure 1. Few of these have a single effect confined to one area. Most have multiple impacts which may be dispersed over the entire region triggering additional hazards in a domino-type reaction. For example, material from a landslide occurring adjacent to a creek bed may come to rest in the stream creating a temporary dam with ponded water flooding upstream areas and causing erosion of stream banks. Eroded sediment, trees, boulders and logs will increase the size of the dam which will eventually burst allowing the debris to flow rapidly downstream in the form of debris flows or debris torrents. Property losses can occur both upstream and downstream and a threat is posed to human life and safety. Transportation routes may be blocked or washed away, causing annoying and expensive delays for those who depend on them.

### 2.1 Human-Induced Hazards

Oil, chemical and other toxic material may be accidentally discharged from ships in the Strait of Georgia, English Bay, Burrard Inlet (three oil spills occurred in Burrard Inlet in 1989), and the Fraser River, or along major rail and truck routes throughout the Lower Mainland (see Figure 2, a hazards map of Vancouver). Toxic materials

infiltrate soils and groundwater regimes, and poison fresh and salt water fish habitats. Dumping of toxic materials into fish-bearing streams has been a particular problem in some areas especially Lynn Creek on the North Shore, and the tributaries of the Fraser River.

Chemicals escaping into the atmosphere from damaged ships, railroad cars, trucks, or storage areas are not readily dispersed due to the urban topography: buildings of various heights, sizes and densities create a turbulent micro-climate. In this atmosphere high concentrations of the chemical are unevenly distributed and less readily dispersed than in open spaces. High concentrations of toxic vapours could linger for a long period of time.

## *Figure 1: Lower Mainland Hazards*

### Natural Hazards

Earthquakes

Landslides, Rockfalls

Bedrock Slope Failure

Debris Torrents, Debris Flows, Mudflows

Snow and Rock Avalanches

Floods

Climatic Changes
(Severe Fog, Ice, Hail, Wind)

Forest Fires (North Shore, Stanley Park)

Subsidence (Sinking of Structures - Lansdowne Mall)

Vulcanoes

Biological (Water Quality, Disease, Epidemics)

### Human Induced Hazards

Pollution (Air, Soil, Water)

Toxic Materials (Chemical, Biological)

- Spillage
- Storage
- Waste Disposal

Transportation Accidents (Aircraft, Ship, Rail, Truck, Bus)

Structural Collapse (Buildings, Bridges, Dams)

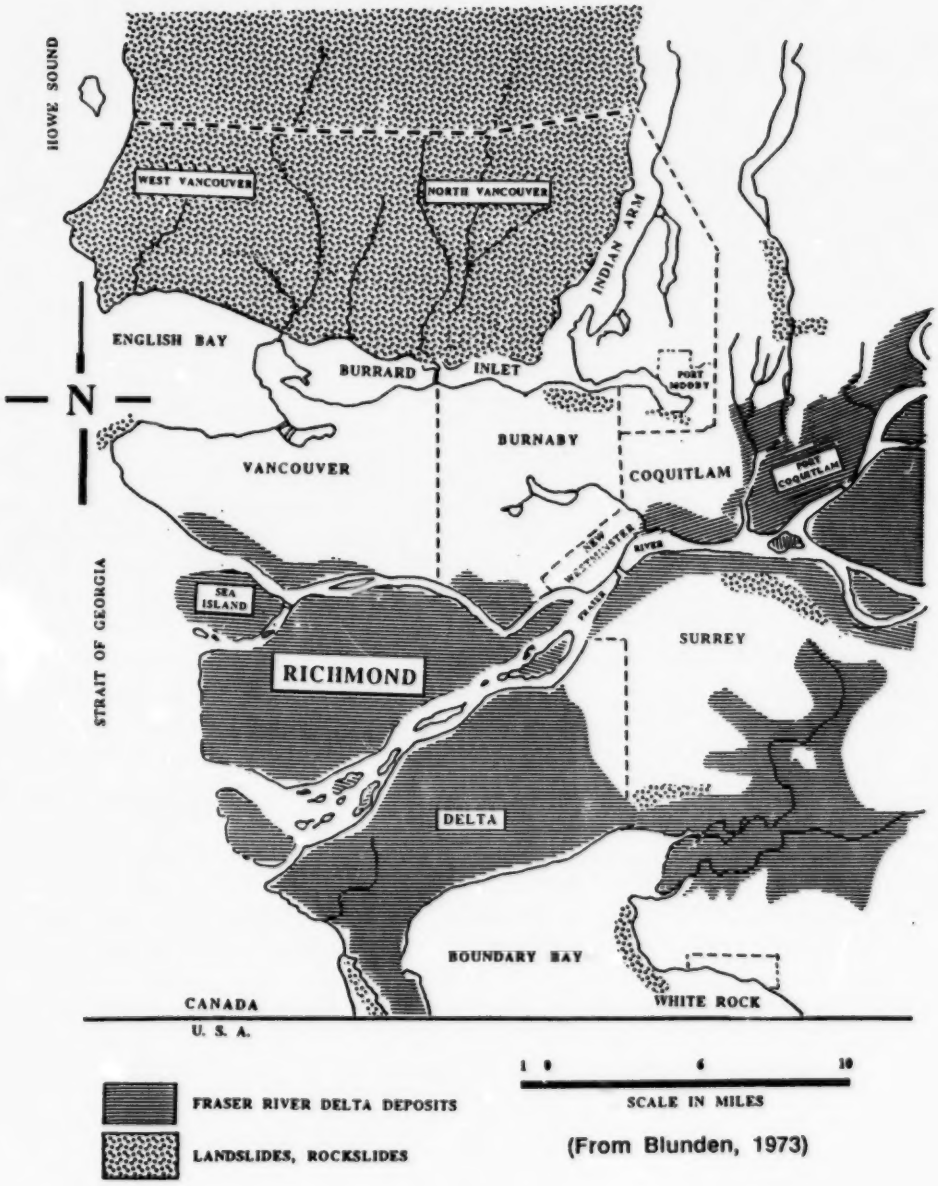
Explosions

Urban Fires

Regional Power, Communications Failures

Socio-Political
- International or Domestic Terrorism (Bombings)
- Riots
- War

## *Figure 2: Greater Vancouver and the Fraser Delta*




(From Blunden, 1973)

### *2.2 Natural Hazards*

Slope failures of various kinds are relatively common in the Lower Mainland and often occur in conjunction with heavy rainfall. Along the Squamish Highway and on the North Shore mountains, bedrock failure and rockfalls may predominate. At lower mountain elevations and elsewhere in the Lower Mainland landslides or earth slumps are common. Increased residential development on slopes and near creeks where erosion and slides of various types often occur has resulted in severe damage to urbanized areas. During a torrential 1979 rainstorm, severe property damage occurred in the Coquitlam-Port Moody area due to earth slumping and mudflows, and along the swollen Mosquito Creek on the North Shore where eroded stream banks collapsed, sweeping away residential property constructed on the banks. Adjacent to the Premier Street Landfill in North Vancouver the flooded waters of the Seymour River undercut its banks dumping mounds of toxic garbage into the waterway (Eisbacher and Clague, 1980). Property damage totalling thousands of dollars was reported due to this storm alone. Other areas with a history of active landsliding are found in Surrey, New Westminster, and along the cliffs of Wreck Beach near the University of British Columbia (Eisbacher and Clague, 1980; Abrams, 1980).

### *2.3 Earthquakes*

Earthquakes are a dramatic example of a hazard which can produce multiple impacts. The effects of an earthquake are due to its magnitude and its acceleration. The measure of magnitude is determined on the Richter Scale which measures energy released by an earthquake using an instrument called a seismograph. The Richter Scale is open-ended and begins with '0'. Each step in the scale represents an increase in magnitude of 10 times so that a 6.0 magnitude earthquake is 10 times more powerful than one having a magnitude of 5.0, 100 times more powerful than one of 4.0. Acceleration is a measure of intensity which is dependent on the magnitude, distance from epicentre, and local soil conditions.

This means that earthquakes as low as 3.0 on the Richter Scale have the potential to initiate various types of slope failure which may in turn trigger floods, mudflows, debris flows or debris torrents. Bridges, highways, roads, homes, and urban structures may be severely damaged either by the shaking motion, liquefaction, or both. Collapse of brickwork and precast cement panels used in structures such as parkades or highway overpasses are common results of shaking and are well illustrated in the Whittier Narrows earthquake of 1987 (5.9 magnitude), and the Courtenay earthquake of 1947 (7.25 magnitude).

In Mexico City, which was 400 kilometers (km) from the epicentre, damage from the 1985 earthquake (8.1 magnitude) was unusually extensive because the soft lake bed

soils amplified the acceleration rate to five times greater than was the case on firm soils or bedrock. This type of increase in acceleration rate would be similar to what could be expected in the Fraser River delta. Buildings in Mexico City were designed for an expected acceleration rate of one-fifth of that received. A common occurrence was the collapse of one or two buildings in a complex while the others remained intact. An example of this was the maternity wing collapse at Juarez Hospital, in which hundreds of mothers, newborn babies and their doctors died. This phenomenon was due to the action of resonance on certain kinds of construction materials. Apartment buildings in the Minoru Park complex in Richmond are similar in height and structure to a building which was severely damaged in the Mexico City earthquake.

Southwestern British Columbia lies in an active seismic region, part of the circum-Pacific belt also known as the Ring of Fire. Many specialists in the geo-technical field agree about the probability of a large earthquake greater than 8.0 magnitude on the Richter Scale occurring in the Lower Mainland. An event of this size could have multiple domino-type effects causing catastrophic damage and loss of life. Within the last 100 years four earthquakes with a magnitude greater than 6.0 have occurred within the Lower Mainland or on Vancouver Island. The last occurred in 1946, had its epicentre (the point at the earth's surface directly above the focus (hypocentre) of an earthquake) in Courtenay, and was 7.25 on the Richter Scale (Rogers, 1979). Because of low urban density, damage was relatively light but if a similar event occurred today, either on Vancouver Island or in the Lower Mainland, severe property damage and loss of human life could be expected.

In the Lower Mainland, new buildings are required to conform to the latest National Building Code of Canada (NBCC) design standards, but older structures do not have to be retrofitted unless undergoing renovations. Some of Vancouver's older buildings may suffer the same fate of the sev rely damaged buildings in Mexico City. There are no regulations such as those in New Zealand where it is stipulated that prospective tenants must be informed if the earthquake design standards are not incorporated into the building (Byrne, 1989).

Liquefaction causing ground subsidence, could occur in many parts of the Fraser River delta, specifically in Richmond and parts of Delta and Ladner (Byrne and Anderson, 1987; Lutenauer, 1989; Liam Finn et al, 1988; Abrams, 1979b). Buildings and other structures in these areas will, in addition to damage from shaking, be subject to uneven ground settlement since differences in soil susceptibility to liquefaction occur on a microscale. This will cause parts of buildings to slump, dip, sag or collapse while other portions remain intact. The type of damage expected is similar to that which occurred in Nigata, Japan, during the 1964 (7.3 on the Richter Scale) earthquake.

Liquefaction was the major cause of damage in Nigata where soils are almost identical

to those in the Fraser River delta. A major problem in Nigata was differential movement and buckling of portions of the airport runway making it unusable. Liquefaction was also a factor in damage to highways and industry in the Courtenay earthquake of 1946 (Byrne, 1989; Lutenauer, 1989; Rogers, 1979). As in Nigata, differential settlement of the ground in the Fraser River delta may cause large cracks in the dykes which would allow serious flooding (Lutenauer, 1989; Liam Finn, 1988; Byrne and Anderson, 1987). Use of runways at Vancouver International Airport and of highways and roads may be disrupted due to differential ground movement causing cracking and lateral spreading which could elevate sections of pavement up to one-half a metre above the adjacent ground surface. Although the airport terminal may remain intact, aircraft will be unable to take off or land.

Transportation routes would be damaged and impassable as occurred to the highway between Campbell River and Kelsey Bay during the Courtenay earthquake, and to a highway and railroad track along an Alaskan coastal mountain route similar to the Squamish Highway between Vancouver and Squamish. Lateral spreading of soil fills on which bridge abutments are placed may disrupt bridge access as happened in Nigata where ground subsidence due to liquefaction caused a bridge approach to sink several feet below the bridge. Bridge damage also occurred when liquefaction (a process in which soft loose soil deposit (e.g. sand, silty sand) is being transformed to a liquid as a result of earthquake shaking or by other dynamic disturbance) of the sand layer in which supporting pilings were sunk caused a bridge to collapse into the river. Differential ground settlement may cause cracking and displacement of concrete sections in the George Massey Tunnel. This may result in flooding within the tunnel. Water geysers up to six feet high may spout through cracks in the ground surface and buried objects may float to the surface (Byrne and Anderson, 1987).

Along the Squamish Highway and on the North Shore mountains, slope failures could trigger rock or snow avalanches, flooding, debris torrents, and debris flows. A preliminary study of the Capilano and Seymour River dams' sensitivity has shown the need for a dam stability analysis in order to upgrade the structure to current technological standards (Byrne, 1989). Landslides throughout the Lower Mainland may cause earth slumps, flooding, debris flows, mudflows and other types of hazards. Disruptions to major transportation routes will likely occur. Human life and safety will be in serious jeopardy, and severe property damage could occur.

In the False Creek area of Vancouver fill soils on the old Expo '86 site are extremely unstable (Clague, 1989), and some of them may liquify. Major problems may occur if building design does not take this soil instability factor into account (Byrne, 1989). Older brick buildings in Gastown and elsewhere may collapse or be severely damaged as happened to stores and banks in Campbell River and Courtenay during the 1946 earthquake, and in Whittier and East Los Angeles during the 1987 Whittier Narrows earthquake. Frame buildings should be bolted to the foundation to reduce the possibility of being shaken off their foundations; this occurred both in the Courtenay

and Whittier Narrows earthquakes. Even when a building is structurally safe, internal objects such as ceiling tiles, fluorescent lights, overhead pipes, electrical wiring and internal beams may loosen and collapse on unsuspecting persons below. Bookshelves and files may move or bend, throwing out their contents and causing further damage and human injury. This hazard could have especially tragic consequences in schools or hospitals. The interior of a Courtenay elementary school classroom was almost totally demolished by falling beams, bookshelves and other classroom paraphernalia while the exterior suffered only a broken chimney as a result of the 1946 earthquake.

During the Whittier Narrows earthquake books fell and book stacks were bent and tilted in the library at California State University at Los Angeles; inside the California Federal Building in Los Angeles, bent fluorescent lights, broken pipes and wires were suspended through holes left by loosened and collapsed ceiling tiles. A supporting structural beam was displaced, filing cabinets were moved, and other office accoutrements were scattered over desks, typewriters and computers. The exterior of this relatively new structure was left intact.

Throughout the region, light to moderate damage will probably occur to water, sewer and gas lines, and to electrical and telephone wires. Fires may start as a result of broken gas mains and downed electrical wires. Because of damage to transportation systems and disruption of water lines, access and ability to contain fires will be curtailed and a conflagration is possible (Byrne and Anderson, 1987).

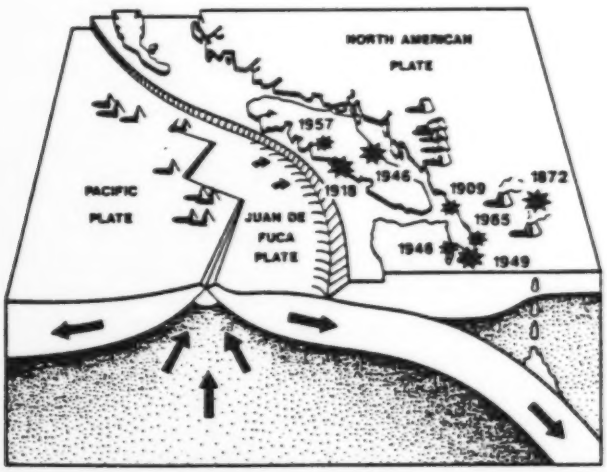
### *2.4 Tectonic Plate Activity*

At present there is serious concern with respect to occurrence of an earthquake in the Lower Mainland measuring greater than 6.5 magnitude on the Richter Scale. The reasons for this concern are that the Juan de Fuca Plate, a small, young and buoyant oceanic plate which extends for 200 kilometres off the west coast of Vancouver Island, is subducting or sliding in a north-easterly direction under the western margin of the North America plate at a rate of 4.5 centimeters (cm) per year averaged over millions of years (Figure 3).

Abrupt plate motions in subduction zones constitute mega-thrust earthquakes of 8.0 or more on the Richter Scale. This magnitude can be compared to the 1985 Mexican earthquake of 8.1 which occurred along a similar fault surface in the Pacific Ocean (Byrne and Anderson, 1987; Clague, 1989). Most subduction zones are characterized by thrust earthquakes but historically none has been detected along the Cascadia Subduction Zone west of Vancouver Island. This implies that the plates are engaged either in a long-term sliding motion, or are locked together and will move abruptly in the future (Dragert and Rogers, 1988). In comparable subduction zones, intervals between thrust earthquakes have been up to several hundred years (Dragert

and Rogers, 1988; Clague, 1989). Many researchers agree that mega-thrust earthquakes along the Cascadia Subduction Zone do occur, not on a regular basis, but on average every several hundred years (Clague, 1989). Recent evidence suggests that because no thrust earthquakes have been detected in the actual subduction zone within recorded history, the Juan de Fuca and Pacific plates are in a locked phase. Research is ongoing to determine when a mega-thrust earthquake last occurred in southwestern British Columbia. Smaller earthquakes have occurred from movement in the overlying continental plate or descending oceanic plate (Dragert and Rogers, 1988). It appears that an earthquake measuring at least 8.0 on the Richter Scale may occur at any time although, of course, the exact day or year cannot be predicted.

***Figure 3: Juan de Fuca Plate***




## *2.5 Conclusion*

The earthquake hazard situation in British Columbia is so serious that Emergency Preparedness Canada (EPC), recently held its first national earthquake symposium, and focused on the federal response to catastrophic earthquake in British Columbia. Similarly, the 1989 annual meeting of the Provincial Emergency Program (PEP) focused on developing provincial emergency plans for the earthquake hazard in British Columbia.

Is the Lower Mainland prepared for an 8.0 magnitude earthquake, or even one measuring 6.5 on the Richter Scale? Is there a coordinated Lower Mainland area

emergency plan to deal with the widespread effects of toxic substance spills, an airline crash or other severe hazards, natural or human-made? How will the various multiple impacts be handled? Is there a cohesive emergency preparedness network which will, when a disaster strikes, immediately coordinate all entities, municipalities and facilities necessary to deal with a disaster of this magnitude, and ensure a smooth and effective operation of rescue efforts, support services and repair work? If, during an earthquake, bridges, airport runways and transportation systems are damaged and unusable, how will necessary supplies be received? For the benefit of all Lower Mainland citizens, emergency activities must be coordinated and a cohesive Emergency Preparedness and Response System must be activated.

## 3. *A Synopsis of the City of Vancouver Emergency Plan*

In conjunction with federal and provincial emergency plans, the aim of the City of Vancouver's Emergency Plan is to provide a basis for coordinating emergency response operations within the City in the event of a major emergency or disaster.

Because there are a number of emergency situations that could affect a city the size of Vancouver, current thinking among City Council and staff is that the development of a detailed plan outlining responses to potential emergencies would be too difficult to administer and coordinate. As such, Vancouver's emergency planning approach focuses primarily on providing an effective response to minimizing public injury and property damage by concentrating on high-risk emergency situations. The emergency plan identifies the following seven emergency situations:

- The manufacture, storage and movement of dangerous goods;
- The possibility of disaster as the result of a major earthquake;
- The possibility of a large passenger plane crashing within the city;
- The potential of an oil spill and its impact on the city's coastline, beaches and harbour;
- The event that civil disobedience may generate social or racial pressures;
- The emergencies that may result from weather-related situations; and
- The possibility that international situations could become unstable and escalate into a conventional or nuclear war.

The degree to which City resources can be used against these high-risk emergency situations largely depends upon the effective planning of the involved civic departments before the occurrence of a major emergency or disaster. To meet that objective, the Vancouver City Emergency Plan provides the city with the legal authority to develop and manage emergency program delivery. The major participating civic departments involved in the emergency program include Police, Fire, City Clerks, Permits and Licenses, Engineering, Health, and Social Planning.

The Vancouver Emergency Plan was approved by City Council in 1979 and is a comprehensive, all-emergency plan which designates who is in charge, coordinates the emergency response, effectively uses resources and coordinates the emergency response of other municipalities, support agencies and senior levels of government. The Plan is an umbrella document which outlines the emergency responsibilities and procedures in general terms, while departmental emergency plans specify detailed responsibilities and procedures.

The Basic Plan, Part I of the Emergency Plan, provides legal authority for emergency procedures and responsibilities. It is approved and amended by Council on the recommendations of the Emergency Planning Committee. The Procedural Manual, Part II of the Emergency Plan, outlines the emergency procedures and responsibilities in general terms and is approved by the Emergency Planning Committee in accordance with the Basic Plan.

The Chief Constable, as the Director of Emergency Operations, and in concert with the Emergency Operations Committee, has the authority to direct and control all emergency response activities, organizations and resources within the City. The Director of Emergency Operations must resolve conflicts on the Committee, assign priorities and be responsible for the evacuation of areas made unsafe by the emergency.

The Emergency Operations Committee is comprised of the heads of all emergency response departments and a representative of the Provincial Ambulance Service. This Committee is responsible for coordinating the activities of their departments in accordance with departmental plans and the Vancouver Emergency Plan. This is a core group and can be expanded to include representatives from other support organizations.

The Plan outlines four phases under which the City's emergency response to a disaster is implemented. They consist of:

- Phase One: Initial reporting of the emergency to identified emergency response agencies.
- Phase Two: Normal emergency response.
- Phase Three: Escalating of the emergency.
  Assessment of situation.
  Critical decisions.
  State of emergency and/or activation of the Plan.
  Public alert.

° Phase Four: Centralized direction and control.
Coordinated emergency response.
Evacuation or relocation.
Emergency facilities established.

The core of Vancouver's Emergency Plan has three major components: the management of communications, the design and development of transportation routes for emergency services and evacuation, and the provision of available emergency support resources. The Plan stresses that effective management of an emergency situation is directly dependent upon prompt, accurate and complete information through an efficient and reliable communication system. To support this requirement, the emergency operations organization has established a variety of overlapping communications systems installed at various city government locations, including an inter-department communication system.

The Plan establishes emergency transportation design, evacuation routes, social service delivery, traffic control and security, and medical service. It presents an inventory of available emergency resources and support services for environmental related disasters (for example: dangerous goods, oil spills, radiation protection, waste management, and so forth).

Although emergency exercises have been carried out on a regular basis, principally by the participating civic departments and senior government agencies, the Vancouver Emergency Plan has not been tested during a real crisis. The Vancouver Emergency Plan is an emergency response document for use by the emergency response organization and is not available to the public.

## 4. Emergency Communications in the Lower Mainland Region of British Columbia

Communications are essential to all phases of the emergency preparedness process including emergency planning, response and post-crisis restoration. It is, in fact, through communication that relationships between emergency preparedness groups as well as individuals are formed, maintained and/or modified.

Disasters bring about demands upon communications which, in turn, have serious impacts upon relationships among responder organizations and the public. For example, during a disaster and under a sense of urgency, circumstances may dictate the formation of new or different types of working relationships, modes of communication, standards and protocols, closer working relationships between public and private organizations possibly operating under different political jurisdictions, and changes in or loss of individual autonomy.

Disasters also bring about expectations of access to public and privately-controlled resources with little or no advance warning. This, in turn, brings about the need for compatible and flexible communications in order to effectively facilitate response and recovery operations.

Within the B.C. Lower Mainland, should a disaster arise, a variety of communications media will be required to fulfil a number of tasks, including alerting emergency responders, warning and informing the public, and directing and coordinating response operations.

### 4.1 Alerting

Alerting involves contacting and mobilizing key personnel to respond to an incident. An effective alerting system must usually rely upon an array of communications methods to ensure that all vital personnel are contacted. Some of the means expected to be deployed in alerting include:

- Telephone fan-out lists;
- Paging systems;
- VHF or UHF radio contact;
- Intercom;

- Door-to-door contact; and
- Commercial radio.

Unfortunately, most of the emphasis on alerting is dependent upon telephone links which may be vulnerable to overloading or physical damage during a disaster. Many organizations rely exclusively upon telephone communications to alert their members and have not developed alerting alternatives. Even paging systems and radio repeater systems are often dependent upon telephone lines to link dispatchers to the radio transmitters.

### *4.2 Warning*

Warning communications are generally most effective when there is prior notice of an impending problem, as with floods, for example. However, even without prior notice, as during an earthquake or with a hazardous goods incident, warnings to the public who are in immediate danger, and require the dissemination of health information and advice, also need immediate communication. To be effective, there must be direct access to the media, including newspapers, radio and television.

A particular problem facing the Lower Mainland is the fact that there are too many information outlets to choose from and there is no method to simultaneously link all of them together during a disaster. Consequently, and due to a general lack of pre-disaster planning in many municipalities, there are no means presently available to ensure that all segments of the population will use a common information channel. Also, not all municipalities have local media outlets. Furthermore, despite the fact that CBC is designated as the primary emergency broadcaster, little work has been done to publicize this fact in most communities.

### *4.3 Informing*

Informing requires providing a continuous flow of information to those affected by a disaster. Although much of the attention may be focused on keeping the public informed, it is also important to keep emergency response organizations apprised of situations. Some of the means used to inform include:

- Personal contact;
- Intercom communications;
- Telephone;
- Radio;
- Television;
- Cable television;

- Loud-speaker systems;
- Newspapers;
- Leaflets and posters; and
- Inter-municipal Emergency Communications System.

Informing, of course, also is essential if successful pre-disaster planning and/or mitigation is to take place. Like warning communication, however, informing communication suffers from the same dilemma of a multiplicity of information outlets.

### *4.4 Directing and Coordinating (Command)*

Directing and coordinating emergency response and recovery operations are perhaps the most critical tasks which communications must facilitate. These tasks will most likely require the establishment of both a command post at the site of the disaster and an emergency operations centre (EOC) away from the disaster site. The role of these facilities is to direct and coordinate activities and communication between the response organizations themselves, and between the response organizations and the public. In order for these activities to be effective, communications must be reliable, efficient and compatible.

Presently, mobile communication within first responder groups (police, fire, ambulance, etc.) is accomplished through the use of VHF and UHF radio, while communication between the groups is usually facilitated over telephone lines by the groups' dispatchers and by personal contact with representatives of each group at the site command centre or EOC. Additionally, communication with other support agencies outside the disaster area may be required such as emergency social services. This requirement, again, is expected to be accomplished through the use of radio and telephone links. Where groups do not possess their own communication facilities or where they may not be adequate to respond to the demand, it is anticipated that backup facilities may be required including amateur radio, runners, and cellular telephones. Despite the vast array of communications resources available throughout the Lower Mainland, a number of communication problems exist that, unless properly addressed, will seriously hamper emergency response efforts during a disaster. Some of the major problems include the lack of resources, incompatibility of radio communication systems, receiver intermodulation problems, and the lack of training.

Radio communication compatibility problems exist, in part, because of the desire of each lead agency to have its own communications flow uninterrupted by other agencies during operations, and because of the regulation of communication frequencies to separate users in order to avoid interference problems. This desire to have discrete systems for normal emergency operations has created a "Tower of Babel" effect where, in a disaster, one agency may not be able to communicate with

another because they do not possess a common radio frequency. Additionally, the increased demand by commercial and non-commercial users to have access to available radio frequencies, coupled with the licensing of frequencies that is done on a first-come-first-served basis has forced emergency agencies to operate in different portions of the radio spectrum. This situation has created such problems as fire departments in adjacent communities being unable to communicate with each other despite the fact that they are required to work together under mutual-aid agreements. Similarly, there is often a lack of inter-agency compatibility between police, fire, ambulance and other radio systems, placing greater emphasis on their dispatchers to coordinate activities by telephone.

In a disaster, another means by which agencies can deal with incompatibility problems is to have agency representatives with access to their particular radio networks (nets) stationed at an emergency operations centre (EOC) and/or a command post at the incident site to ensure proper coordination of services. This requirement is self-evident if those given the responsibility of directing operations are to have rapid access to the ongoing changes in the situation at the site, all of which could not be passed via an individual radio network.

Finally, efforts are underway to develop new "umbrella" networks which provide common operating frequencies between agencies. Two of these networks have been installed in the Greater Vancouver area through the Greater Vancouver Regional District (GVRD). One of these systems was established eight years ago to provide a single VHF radio channel to link together eight of the larger hospitals and Emergency Health Services in the Greater Vancouver Regional Hospital District. Unfortunately, smaller hospitals in the same regional district and those in adjacent regional districts are not part of this network and do not possess alternate inter-hospital radio communications capabilities.

The second Regional Emergency Planning Committee-sponsored network is the Inter-municipal Emergency Communications System which is designed to link all of the municipal emergency operations centres in the GVRD through dedicated radio channels. Aside from base stations located in the EOCs, the system also provides packages of portable radios which are intended to be used by the various emergency responders, allowing them to communicate on a dedicated channel to assist in the coordination of multi-agency responses. This system is by far the most sophisticated of the two systems. However, like the hospital system, there are no links to EOCs located in adjacent Lower Mainland regional districts nor, at present, to the Provincial Emergency Program Vancouver Zone office or PEP Victoria Headquarters. Another problem which must be addressed is radio receiver intermodulation in which frequencies in a spectrum-saturated area such as the Lower Mainland create difficulties for radio receivers to properly filter out other unwanted signals. This problem results in the audio of other signals interfering with the audio of the licensed frequency and making reception extremely difficult.

In many cases where no networks exist or existing ones fail during a disaster, it is assumed by most levels of government that amateur radio will fill the void. This notion is based upon the recognition that amateur radio operators, although hobbyists, possess some of the most advanced and potentially portable radio equipment available. Such equipment is capable of transmitting over a vast array of radio frequencies, and thus makes it possible to quickly establish alternate networks with skilled radio operators. While this notion may be true, in reality there is little support or official recognition given to these volunteers. As such, there is little incentive for them to be actively involved in local preparedness programs, with the consequence that only a fraction of all licensed amateurs are actually registered with emergency programs. This lack of institutional support perhaps is best exemplified by the fact that, for the past two years, the Provincial Emergency Program has provided no training or training funding for amateur radio volunteers and yet, PEP still relies exclusively upon amateur radio to link its Victoria headquarters with the rest of the province during disasters.

The lack of communication training also exists in many other areas of emergency preparedness activity. Until last year, there were no specific training courses for municipal emergency communications. Emergency Preparedness Canada has begun training municipal emergency communications officers but only has an intake of two students per province per course. Efforts are also underway at Simon Fraser University to establish a teaching and research program in this area, but it too is still in the early development stages.

### *4.5 Special Protection for Telephones*

It is important to recognize that the telephone system is not designed to simultaneously handle all of the telephone lines attached to it. During a major emergency, the telephone system may become overloaded, rendering it useless. As a means of safeguarding telephone service for essential public, safety, and other identified users during these times, the federal Department of Communications (also known as Communications Canada) in cooperation with the B.C. Provincial Emergency Program and British Columbia Telephone Company, has initiated a program known as Line Load Control (LLC). For those telephones served by electronic exchanges, when activated, LLC is intended to give priority access to identified users in originating calls, while temporarily delaying non-essential calls on a rotating basis. LLC does not affect the ability of any telephone to receive calls.

Consequently, during times of abnormal conditions, those telephones protected by Line Load Control are to be guaranteed priority access to a dial tone required for originating calls. This protection also extends to pay telephones which are automatically protected by B.C. Telephone under the LLC program. Others not

registered in the LLC program may have access to a dial tone but such access can not be guaranteed. LLC is to be implemented only when conditions dictate its requirement and will be suspended as soon as line loading permits.

In theory LLC provides additional protection for those involved in emergency out-calling activities. In practice, however, it is difficult to ensure that all essential users who need access to the telephone network are registered or keep their phone number listings up to date.

### *4.6 Recommendations*

Recognizing the essential role that communication plays in all forms of emergency preparedness activity, it is recommended that more emphasis be placed on research and training in this area. An essential component of this work should focus on translating the technical language associated with communications into lay terminology and ensuring that communications planning is properly imbedded into all levels of emergency planning.

Finally, more financial support must be provided for the upgrading of emergency communications systems in the Lower Mainland to take into account the increased level of risk associated with increased urbanization and industrialization.

## 5. *Emergency Planning -- A Planning Process for the Next Decade*

Disaster researchers have consistently complained that disaster planning is product oriented (that is, the written plan) instead of being process oriented (Wenger, Faupel and James, 1980; Quarentelli and Kreps, 1971). Disaster planners have understood that it is their responsibility to develop emergency response plans; and these plans have often been drawn up with little outside involvement save for a few specialized agencies such as the police and fire departments. Disaster planners often neglect to see the production of an emergency response plan as simply one step in the development of an overall plan.

By looking at planning as a process which involves both individuals and groups, and produces more than one output, we can see that there are additional advantages to the community. There are three outputs from planning to be considered: the written plan, action which leads to change, and the feelings and ideas which are generated among the people who participate in the process and who observe it (Boothroyd, 1986).

In order to arrive at a plan that allows for all three of the above results, one way of examining the situation is to develop a systematic planning approach. The first step is defining the primary goals of a disaster plan. These are to:

- **P**reserve Life;
- **R**educe Suffering;
- **E**ducate and Exercise;
- **P**rotect Property;
- **A**nticipate and Mitigate;
- **R**econstruction and Renewal;
- **E**valuate the Incident and the Response.

It follows that the planning approach used needs to establish what the hazards and risks are in the area. How can a planner start to develop a plan without knowing the risks facing the community?

### *5.1 Community Preparedness*

Literature and practice support the fact that the community at large is seriously uninformed regarding existing hazards. Furthermore, the community is also unaware of how to go about minimizing the effects of these hazards in order to reduce damage to property and persons.

Therefore, as a first step the emergency planner needs to improve his or her own awareness of existing hazards and risks to a community. Secondly the planner needs to work with the community regarding these hazards and risks. The disaster planner needs to develop an awareness at three levels: the individual and family, the first and secondary response agencies and the politicians.

Research has shown that people as a whole react in the emergency response period of a disaster much better than is usually expected (Quarentelli, 1982). In fact, most people turn to neighbours and family for assistance and support before they turn to formal government or other agencies. As well, in widespread disasters, organized first-response agencies will be unable to meet the emergency needs of the community, and the public must be taught the principles of self-sufficiency and the error of depending on "the government" to meet their needs. Every citizen has a responsibility to mitigate the risks of living in their own community.

Specialized agencies need to be made aware of existing hazards and risks and the necessity to take responsibility for their participation in a planning process. They need to understand that their role is not just in accepting responsibility within the confines of a written plan, but a commitment toward the reduction of risk for themselves, their families and their community.

Most planners would agree that emergency planning needs to obtain a higher priority before changes can be obtained (Kartez, Hunter and Kelley, 1985). With increased public awareness, public pressure groups will start to force public officials and government administrators to increase funding and support. Political support is crucial to the development of training programs for the community in order to educate residents, before a disaster strikes, how best to save lives and protect their property.

### *5.2 Alert and Warning*

Some disasters strike with little or no warning (for example, earthquakes) while others provide an extended warning period. Educating the public about how to protect themselves despite the lack of a warning period is important, but it is also important to provide, where possible, the maximum warning time in order to mitigate losses. Not only does a warning or alert system have to be put in place, and not only does

it have to reach the intended population, but when residents hear of the warning, they must know what to do (for example, evacuate).

Not only does the general public need to be aware of the impending disaster, but those who have specific responsibilities under the emergency plan must also be contacted in order to activate the response plan. In order for the response plan to be effective, all first-responders must be made aware of the plan, since the value of an emergency plan is negated unless all participants required to function under the plan are informed both of the plan and of their designated role.

The disaster planner is aware of the problems created by the media at the scene of a disaster; the need for information and to capture the drama of the situation often interfere in the assessment of damage and the rescue operations. However, the need to warn and alert the community at risk should provide a signal to the planner to include the media as the initial response agency, for it is the media in their various forms who will serve to inform the community of danger. The media need to be made aware of the importance of their participation in the plan, and to develop a communications protocol which provides the public with consistent, accurate, and relevant information.

### *5.3 Immediate Post-Impact*

As previously mentioned, the community must be prepared to be self-sufficient during the early stages of a disaster, approximately for 72 hours. Through prior planning, the community at the municipal and neighbourhood level will have developed a means of identifying those who are at special risk (for example, the handicapped and elderly) and will have provided a structure to meet immediate needs.

The first priority of first-response agencies is to assess the damage and to determine the areas most in need of assistance. Communication is a key element to damage assessment, and since traditional means of communicating (such as the telephone) are often not functioning after a disaster, alternative means of communicating in the immediate post-impact phase must be developed and financially supported. When municipal police forces cannot communicate with the RCMP, firefighters or ambulance personnel in normal day-to-day operations, how can we expect them to provide a coordinated and efficient service in times of crisis?

Search and rescue (SAR) operations are critical in saving lives and yet SAR resources in the Provincial Emergency Program (PEP) are rural oriented for "lost in woods" activities and its personnel are not trained for collapsed structure search or heavy rescue. Not only do we not have trained SAR volunteers available in case of disasters which cause structural damage (for example, earthquakes), but even if there were

trained volunteers, there is no specialized equipment available for them to use. Therefore, SAR must be organized with a good control system with direction, communications, equipment and training.

Although research would indicate that most communities have disaster plans, fewer than half of those communities have provision for any training or simulation exercises built into the plan (Seismic Safety Commission, 1979). Exercises are not popular for a number of reasons: they take up time, they cost money, and they require public participation. Because "exercises sometimes embarrass the department heads" (Kartez, Hunter and Kelley, 1985) they are often avoided. So often the exercise involves only the participation of chiefs or department heads, and these chiefs and department heads exclude operational personnel. If a first-response agency does have an exercise, it tends to be solely "in-house" and to exclude other agencies except on a peripheral basis. Exercises conducted by first-response personnel seldom, if ever, include secondary response personnel such as building inspectors for damage assessment, insurance companies, or mental health workers.

### *5.4 Reconstruction and Renewal*

The first need in the reconstruction phase is information: what happened, what was the impact, what resources are needed and how can they be obtained? Disaster planning has, in the past, stopped at the end of the rescue phase and has not looked at the needs of reconstruction and community renewal. The first step, therefore, is to provide a means of distributing information to the general public about the existing situation. While persons cope well on their own during the post-impact and rescue phase, they do less well during the long-term recovery phase. Concerned about their own losses, they want to know how to begin to put their lives back together again. The provision of Local Reception Centres needs to be included in the plan, not solely as a means of providing shelter or clothing depots, but as a one-stop information and resource centre. It should include access to unemployment insurance, workers' compensation, government pensions, insurance, mental health, financial and other necessary services.

All three levels of government need to collaborate on identifying heavily damaged areas, and areas still presenting special hazards. Citizen Advisory Committees should be formed so as to assist officials in the development of recovery and reconstruction plans.

A public information program needs to be established in order to provide information for home owners on procedures and "How to do it" instructions. Businesses, both large and small, also need to be made aware of local, provincial and federal assistance

programs and how to gain access to these funds. The impacts of reconstruction must not be ignored when implementing a community economic redevelopment program.

### *5.5 Land Use Planning*

Just as the public and politicians are unaware of existing hazards and risks in their communities, urban and land-use planners are guilty of failing to take into account emergency preparedness when developing community plans.

The first step for land-use planners to take is to review the hazard and risk analysis report with the disaster planner. Once made aware of risks the community faces, the next step is to evaluate the impact of these risks. This will necessitate the collection of information on critical facilities and high occupancy buildings; dangerous goods storage, buildings and open areas with potential for emergency housing, heavy equipment, construction materials and debris. A review of existing buildings by type of structure and occupancy together with information on public and private infrastructure will need to be conducted in order to provide the necessary information for making damage predictions.

Once the areas and buildings which may be subject to heavy damage and loss of life are identified, planners need to recommend measures which should be taken to reduce these risks. These may include changes in land-use plans, building regulations and permits, building codes and enforcements of the codes, and upgrading or retrofitting of existing infrastructure and critical facilities such as hospitals. Planners should also encourage owners to make relatively low-cost high-payoff corrections to existing structures and facilities (for example, anchoring water heaters) and should recommend to government bodies tax incentive programs to maximize community participation.

The formation of Citizen Advisory Committees at this stage of the planning process will be of great assistance when a disaster actually strikes. Land-use planners need to develop an emergency plan in conjunction with the disaster planner, in order to facilitate the identification of areas of damage immediately following a disaster, the procedures for making changes to community plans in newly existing hazardous areas, and for a mechanism of expediting permits for reconstruction and development following a wide-spread disaster.

## 6. Recommendations

No-one ever wishes to actually have to deal with the consequences of a disaster, but time and time again researchers have shown that the prepared community is better able to cope following the impact and is quicker to recover. It is each individual's responsibility to ensure that they, their family and their community are prepared.

In view of the identified problem areas, The Forum for Planning Action Sub-Committee wishes to make a number of recommendations for consideration. These are presented as follows:

### 6.1 Community Preparedness

1. That thorough and in-depth hazard and risk analysis be completed at the municipal level and that community planners, first responders and emergency planners work together in this effort.

2. That a public relations strategy be developed to reach schools, public groups, and general organizations via videos, pamphlets, colouring books, T.V., radio programs, newspaper and magazine articles regarding existing hazards, self-survival kits and home-owner programs.

3. That a political strategy be developed to increase awareness of potential risks at the municipal, provincial and federal political level.

4. That communication links be established and used to facilitate information sharing between scientists, planners and the community at large.

5. That emergency response exercises be more frequent, multi-agency, and include community participation.

6. That funding to universities and post-secondary institutions be increased in the areas of emergency planning. That this funding include for the provision of a resource centre for the collection and distribution of disaster related materials.

7. That additional scholarships be offered to post-secondary students wishing to study in the area of emergency planning.

8. That additional emphasis be placed on research and training in the area of communications, specifically to include translating technical language associated with communications into lay terminology, and ensuring that communications planning is included at all levels of emergency planning.

9. That a program to increase public awareness regarding the United Nations International Decade of Natural Disaster Reduction be implemented, and that all levels of government be encouraged and supported in developing programs related to emergency preparedness.

10. That a 5% surtax be placed on property insurance policies to assist municipalities to finance their hazard management planning and emergency preparedness programs.

11. That municipal hazard management planning committees be established to:

    - identify potential hazards;

    - ensure that hazard issues are taken into account as part of proposed land use policy formulation, permit processes, transportation planning and related projects and developments; and

    - assist the municipal emergency planning committees in post-emergency recovery.

12. That municipalities take the initiative and serve as a model for the community by ensuring that its own buildings and facilities are safe from structural and non-structural damage. Municipal employees and their families should be trained and prepared to deal with disasters.

13. That consideration be given to the large number of residents and visitors from different multi-cultural backgrounds. Persons who have difficulty speaking or comprehending the common language of the community will have increased difficulty in coping at all stages of a disaster. Translations of warnings, building inspection placards, and emergency preparedness pamphlets should be available prior to the disaster.

### *6.2 Alert and Warning*

14. That national, provincial and municipal warning and alert systems be linked to various media, and that the need to develop neighbourhood warning systems be promoted.

15. That Line Load Control be instituted in order to ensure maximum communication in the warning and immediate post-impact phases of a disaster.

### *6.3 Immediate Post-Impact*

16. That more financial support be provided for the upgrading of emergency communication systems in the Lower Mainland, to take into account the increased level of risk associated with increased urbanization and industrialization.

17. That ham radio groups be provided with financial support for equipment and training costs.

18. That Search and Rescue (SAR) needs to be brought to the attention of politicians, and that a structure be developed so as to provide the capability to save lives after the impact of a disaster causing major structural damage.

19. That communication alternatives be explored so as to ensure that intra- and inter-agency communication is made possible during the rescue phase of a disaster.

### *6.4 Recovery and Reconstruction*

20. That private and public agencies be contacted and that a plan for one-stop service delivery be implemented at Local Reception Centres.

21. That recovery and reconstruction plans be developed, and these plans include community economic recovery planning.

22. That planners begin to develop provisions for contingency plans for reconstruction and renewal that include Citizen Advisory Committees.

23. That municipalities develop a corporate disaster recovery plan including such programs as essential records preservation, business resumption and critical incident stress debriefing. Municipalities should cross-train employees to work in the departments that will bear the brunt of service delivery demands following a disaster such as engineering, social planning, permits and licenses and building inspections.

### *6.5 Land Use Planning*

24. That land use planners begin to collaborate with emergency planners in approving land use zoning, development permits, building code inspections and regulations.

25. That urban planners identify and target retrofitting of critical facilities and specific neighbourhoods subject to heavy damage when impacted by potential hazards.

## References

Abrams, Angela (1979a) *Map of Geological Hazards of the Lower Mainland of British Columbia.*

Abrams, Angela (1979b) *Map of Soil Sensitivity to Seismicity in the Lower Mainland of British Columbia.*

Abrams, Angela (1980) *Present Geological Hazards and Soil Sensitivity to Earthquake Movement for the Lower Mainland Official Regional Plan Review,* Prepared for the Resource Analysis Branch and Ministry of Transportation, Communications and Highways, Geotechnical Branch, Province of British Columbia, Ministry of the Environment.

Association of Professional Engineers of British Columbia (1988) *Seismic Risk in British Columbia,* Brief to the British Columbia Government.

Boothroyd, Peter (1986) *Handbook on Community Planning Process,* Regina, Saskatchewan: Saskatchewan Indian Federated College, March.

Byrne, Peter M. and Donald L. Anderson (1987) *Earthquake Design in Richmond, British Columbia (Version II),* Soil Mechanics Series No. 109, Department of Civil Engineering, University of British Columbia.

Byrne, Peter M. (1989) Department of Civil Engineering, University of British Columbia, Personal communication.

Charlwood, Robin G. and Gail Atkinson (1983) "Earthquake Hazards in British Columbia", *Journal of the Association of Professional Engineers of British Columbia,* December, pp. 14-16.

City of Vancouver (1979) *Emergency Preparedness Program.*

Clague, John J. (1988) Geological Survey of Canada, Personal communication.

Dragert, H. and G.C. Rogers (1988) "Could a Megathrust Earthquake Strike Southwestern British Columbia?", *GEOS,* Summer, 17:3, pp. 5-8.

Eisbacher, G.H. and John J. Clague (1981) "Urban Landslides in the Vicinity of Vancouver, British Columbia, with Special Reference to the December, 1979 Rainstorm", *Canadian Geotechnical Journal*, 18, pp. 205-216.

Environment Canada (1986) *Bhopal Aftermath Review: An Assessment of the Canadian Situation*, Ottawa: Government of Canada, March.

Government of Canada, Province of British Columbia, Greater Vancouver Regional District (1986) *Vancouver Area Transport of Dangerous Goods Study*, Ottawa: Government of Canada, Volume 4, Geographic Information System, Executive Summary.

Hay, Duncan (1983) "Tsunamis", *Journal of the Association of Professional Engineers of British Columbia*, December, pp. 17-20.

Kartez, Jack D., Liese Hunter and William J. Kelley (1983) "Sharing Emergency Planning Assumptions", *Carolina Planning*, 2:1, pp. 10-18, 45.

Kreps, Gary A. (1978) "The Organization of Disaster Response: Some Fundamental Theoretical Issues", E.L. Quarantelli (ed.), *Disasters: Theory and Research*, Beverly Hills, California: Sage Publications.

Liam Finn, W.D., D.J. Woeller and P.K. Robertson (1988) *An Executive Summary of Liquefaction Studies in the Fraser Delta*, Ottawa: Geological Survey of Canada, Prepared for Energy, Mines and Resources Canada.

Lutenauer, John L. (1988) *Geoarchitecture, Evolution and Seismic Risk Assessment of the Southern Fraser River Delta, British Columbia*, Current Research, Part E, Geological Survey of Canada, Paper 88-1E, pp. 105-109, (Unpublished).

Lutenauer, John (1989) Personal communication.

Quarantelli, E.L. (1982) "Social and Organizational Problems in a Major Community Emergency", *Emergency Planning Digest*, January-March, pp. 7-10, 21.

Quarantelli, E.L. (1984) *Organizational Behaviour in Disasters and Implications for Disaster Planning*, Emmitsburg, Maryland: National Emergency Training Center, FEMA.

Rogers, Garry (1980) "A Documentation of Soil Failure During the British Columbia Earthquake of 23 June, 1946", *Canadian Geotechnical Journal*, 17, pp. 122-127.

Seismic Safety Commission, State of California (1985) *Preliminary Reports,* Submitted to the Seismic Safety Commission of the May 2, 1983 Coalinga Earthquake, SSC 83-10. California, July 14.

Wenger, D., C. Faupel and T. James (1980) *Disaster Beliefs and Emergency Planning,* New York, N.Y.: Todd Publications.

## *About the Authors*

**Peter Anderson** is a professor in Emergency Communications at Simon Fraser University currently on leave at Melbourne University in Australia.

**Nathan Edelson** is a planner with the Planning Department of the City of Vancouver and Vice President of the Forum for Planning Action.

**Betty E. Hansen** is a Graduate Student in Physical Geography, Simon Fraser University.

**Ruth Harding** recently completed her degree in the area of Emergency Communications at Simon Fraser University.

**Kari Huhtala** is employed with the Corporation of Delta as a Project Planner. His interest in the field of natural hazards resulted from his graduate thesis at The University of British Columbia on floodplain management practice.

**Laurie Laughy** is currently a Ph.D. candidate at the School of Community and Regional Planning at The University of British Columbia. She has been involved in Emergency Planning since 1981, and completed a thesis on Disaster Planning Theory in 1989.